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Vol. 16.] DECEMBER, 1945. [No. 4.

AGRICULTURAL JOURNAL

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Vol.

1. 3 numbers, 1928.
2. 4 ,, 1929.
4. 4 ,, 1931.
5. 2 ,, 1932.
6. 2 ,, 1933.
7. 1 number, 1934.
8. 4 numbers, 1935-37 (None of Nos. 2 and 4).
9. 4 numbers, 1938 (None of No. 2).
10. 4 ,, 1939 (None of No. 4).
12. 4 ,, 1941 (None of Nos. 1 and 2).
13. 4 numbers, 1942.
14. 4 ,, 1943.
15. 4 ,, 1944.

ISSUES OF THE AGRICULTURAL CIRCULAR.

THE following were the numbers and year of issue of the *Agricultural Circular*:—

Vol. 1, 1920, 12 numbers.
,, 2, 1921, 5 ,,
,, 3, 1922, 4 ,,
Vol. 4, 1923, 1 number.
,, 5, 1924–5, 2 numbers.

As number 4 of Vol. 3 was printed as " Volume 4 " and number 1 of Vol. 4 as " Volume 5 " it would appear from an inspection of a complete set that Volume 4 comprised only a number 4 and that there were two issues of Volume 5, Part 1.

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Applications should be made to the Librarian, Department of Agriculture, Suva, Fiji.

—EDITOR.

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AGRICULTURAL JOURNAL

ISSUED BY THE

DEPARTMENT OF AGRICULTURE, FIJI.

VOL. 16.] DECEMBER, 1945. [No. 4

EDITORIAL.

INSECT PESTS FROM INWARD PLANES.

AFTER an attempt in November 1941 to establish a regular air line to and from Fiji there has, inevitably, been a lapse of four years without a civilian plane service. However it is now necessary to reconsider the ever present possibility of the unintentional introduction, both by planes and ships, of insects, sometimes serious pests, particularly from the islands lying to our west. The following table shows at a glance the time taken by a plane compared with an average merchant vessel to reach Fiji from some other Melanesian islands:—

To Fiji from.	Distances* in statute miles.	Ship sailing 270 miles per day (to the nearest day).	Plane flying at 150 miles per hour.
New Caledonia	825	3 days	5½ hours.
Espiritu Santo	766	3 ,,	5 ,,
Guadalcanal	1,350	5 ,,	9 ,,

It will be noticed that a plane can fly to Fiji from New Caledonia in the time taken to drive in a car from Suva to Lautoka. This means that all kinds of vegetable matter (such as ripe fruit and vegetables and fresh flowers) which would be perishable on a journey by ship can readily survive the brief air passage and so be landed.

It is hoped that everyone to-day realizes the danger involved in bringing in undeclared plant matter and how easy it is at the point of embarkation to secure an official declaration from the Department of Agriculture certifying that nothing is being carried which is likely to harbour insect pests, plant disease germs or viruses. Without going into the ethics of the question, it is true to say that once such dutiable goods as gems or jewellery have been smuggled into a country the actual harm ends there, whereas with unexamined plant matter there is always the danger that incalculable future harm may result from its unauthorized arrival. Knowledge of this and directing attention to it is not crossing one's bridges before arriving but is common sense.

In the islands which lie to the north-west of us are many insect pests absent from Fiji but which if once established here would cause serious damage and be difficult and costly to eradicate. With the popular press now full of the capabilities of DDT and 666 there is a tendency to think we have in them a weapon which can exterminate all undesirable pests. Even if this were completely true, and unfortunately it is not, it is still as sound a policy as ever before that prevention is better than cure. Readers of this *Journal* may remember what appeared in our issue for December

* These distances are approximate as obviously harbours and aerodromes on any island are some distance from each other and ships do not take the shortest distances between two ports. Main harbours, however, are usually near sea-plane bases.

1941 concerning regulations insisted upon by the Government of the United States of America regarding fruit and vegetables arriving in the States in Pan-American Airways planes via New Caledonia, Fiji and Hawaii.

Fiji, placed as she is in between Australia, New Zealand and Honolulu, is surrounded by countries where the Mediterranean fruit-fly and cabbage white butterfly occur and these, as well as many tropical insects of Melanesia, are potential invaders we wish for the good of everyone in the Colony to keep out indefinitely.

Members of the public proposing to return to Fiji by air with matter of vegetable origin are urged in their own interests to make prior application to the Department of Agriculture listing the material it is proposed to bring into the Colony. —R.J.A.W.L.

CLEARING TIMBER BY BULLDOZER.

An interesting account has recently been given of trials with a bulldozer in Western Australia in clearing timber on land required for cultivation*. The Tractor used was a D7, caterpillar type, owned and operated by the Public Works Department. (Note: the D7 tractor is a caterpillar type, 70 h.p.) Operating costs were estimated at £10 per day of eight hours.

Trials and demonstrations were undertaken on a number of properties and the following summary indicates the performance of the bulldozer under West Australian conditions:—

(1) Virgin redgum-jarrah country, timber density of 100 to 150 trees per acre, six inches to three feet in diameter, light gravelly soil on clay subsoil.

Clearing of 26½ acres was completed in four working days, leaving nine trees to the acre over two feet in diameter on 22 acres and six trees to the acre on the balance of four and a half acres.

(2) Twenty-five-year-old re-growth kauri and redgum saplings 6 to 12 inches in diameter on deep red sandy loam soil, 400 trees to the acre.

Clearing of 20 acres was completed in 37 hours, leaving 20 trees standing to the acre. Approximately 20 per cent of the trees were broken off; the karri was particularly difficult to root out.

(3) Redgum and kauri saplings up to 12 inches diameter, 60 to the acre, and blackboys about 250 to the acre.

Twenty-two acres cleared in 32 hours, one tree to the acre left standing, 10 per cent broken off, all blackboys taken out.

(4) Four hundred to 500 blackboys to the acre and five to six dry trees one to two feet in diameter.

Eighteen acres cleared in 18 hours, and blackboys swept into windrows.

(5) Redgum and kauri saplings up to 12 inches diameter 60 to the acre, and blackboys. Seven acres in 11 hours.

(6) Dry redgum and jarrah, one to three feet in diameter, 150 to the acre.

Nineteen acres cleared in 26 hours, all trees being swept into heaps ready for burning, only five trees being left standing.

(7) Five hundred and fifty blackboys to the acre on average, up to 900 per acre.

Eight acres cleared in eight hours with a 12 foot blade, breaking off being only two per cent; the D7 was working on about one-third of its power.

—C.H

REFERENCES

* Bulldozer Demonstrations. Clearing Virgin country in South-coastal areas. By M. Cullity and C. W. Tobin. *Journal of Agriculture of Western Australia*, Vol. XXII (second series) No. 1, March 1945.

SOIL INVESTIGATIONS—PART 5.

A NOTE ON THE SOILS OF NADALA, COLO NORTH.

By

C. HARVEY and W. J. BLACKIE.

DURING a visit to Nadala, Colo North in August 1944, for the purpose of examining the potentialities of the area as a mixed farming settlement opportunity was taken to perform a limited survey of soil conditions and collect samples for chemical examination.

Locality.—The soil samples referred to subsequently were taken at various points on the land known as Native Grant No. 2 (R.R. 77) Nadala and R.R. 77 Nabuiluva. Their approximate location is shown on a tracing of the area on file in the Department of Agriculture. The area covers the concessions held by the Fiji Kauri Timber Company Limited.

Climate.—The area lies at an elevation ranging from 2,000 feet to 3,500 feet and includes Mt. Victoria (4,341 feet). Temperatures vary from 42°F. to 90°F. but may reach as low as 40°F. The rainfall is recorded as 140 inches with 168 wet days at Nadarivatu and 233 inches with 187 wet days at Navai, the Fiji Kauri Company's mill.

Vegetation.—Most of the samples were taken within the Timber Company's concession in areas which (except where otherwise stated) have been logged within the past ten years or so, leaving unsaleable standing timber among which there is much secondary growth of timber and also weeds and grass where the canopy is sufficiently open.

Topography.—There are many streams and the country is cut up by a number of fairly steep ridges. The slopes are more gentle towards the valley bottoms but flat land is relatively small in proportion. Samples 611 to 616 and 621 to 625 were taken in gently sloping or flat land towards the bottom of the valley; samples 617 to 620 were taken from the top and side of a ridge down toward the valley floor and samples 626 and 622 were taken from the Government Station at Nadarivatu.

DETAILS OF SOIL SAMPLES.

Sample 611 is a subsoil taken from a cutting along tramway lines about 1½ miles above Navai Mill to south, depth 12–15 inches. Surface soil—brown 4–6 inches depth, overlying red-brown subsoil changing to red with depth, no well defined horizons except between surface and subsurface at 6 inches. The slope was 10 per cent near bottom of valley. The forest was logged four years ago and is now under secondary growth with Solanum, Köster's curse and coarse grasses.

Sample 612 is a surface sample taken about 200 yards from 611, and is apparently the same soil type. Land is under short grass cover with "curse", blue rattail and sparse scrub. This area is said to have been cultivated by Fijians some 60 years ago but is now sparsely grazed by Indian owned cattle.

Soil No.	Coarse Sand per cent.	Fine Sand per cent.	Silt per cent.	Clay per cent.	pH	Nitrogen per cent.
612	3.97	14·25	17·57	67·21	5·01	0·299
611	1·37	5·11	11·16	82·31	5·35	0·010

These samples are heavy clay acid soils with clay content increasing with depth; the surface soil has a good nitrogen content.

Sample 613 is a surface sample taken on the gentle slope above the valley bottom; forest has been logged, otherwise undisturbed and carries fairly dense secondary forest and undergrowth.

Sample 614 is a subsoil lies 9 to 12 inches below sample 613. The profiles was not observed.

Soil No.	Coarse Sand per cent.	Fine Sand per cent.	Silt per cent.	Clay per cent.	pH	Nitrogen per cent.
613	1·82	5·01	14·95	78·21	4·52	0·340
614	2·55	4·97	14·57	77·90	4·87	0·320

These samples are heavy clays similar in most respects to Nos. 612 and 611 although slightly more acid; the nitrogen contents are high.

Sample 615 is a surface sample taken at the head of the valley (end of tram line) at the valley bottom near stream. The area was originally under timber but is now under grass, heavy Solanum and guava.

Sample 616 is a sub-surface sample taken at 9 to 12 inches below 615.

Soil No.	Coarse Sand per cent.	Fine Sand per cent.	Silt per cent.	Clay per cent.	pH	Nitrogen per cent.
615	8·03	10·19	16·05	65·70	5·78	0·391
616	7·09	9·94	9·67	70·96	5·43	0·224

These samples are acid heavy clays similar to previous samples. Nitrogen contents are high and acidity is somewhat lower than 612 and 613.

Sample 617 is a surface sample taken at Koro Soi, the top of the divide between the Wainimala and Sigatoka River systems. The land is under heavy secondary timber and undergrowth following logging during the past two years and the soil was undisturbed.

Sample 618 was a sub-surface sample taken at 9 to 12 inches below 617.

Sample 619 was taken at 12 feet depth about 50 yards distant from 617 and 618. The profile showed surface and sub-surface grey brown to brown passing into red brown and mottled grey with depth. Definite horizons were not developed.

Soil No.	Coarse Sand per cent.	Fine Sand per cent.	Silt per cent.	Clay per cent.	pH	Nitrogen per cent.
617	3·84	11·73	17·09	67·33	4·67	0·314
618	1·55	6·32	13·39	78·79	4·48	0·165
619	14·02	20·23	38·21	27·49	4·87	0·017

The surface sample is similar to 612, 615 and is an acid heavy clay with high nitrogen. As with previous samples the immediate subsoil is slightly more clayey and there is a suggestion that the clay content decreases with depth.

Sample 620 is a shallow soil about 2 to 4 inches in depth taken from the top of the cutting on a 20 per cent slope at Korosamoa half way down the ridge towards the valley bottom. The profile shows shallow surface and sub-surface soils from 9 to 12 inches dark grey brown, damp followed by decomposing rock. Pieces of decomposing rock occur at from 6 inches from the surface.

Soil No.	Coarse Sand per cent.	Fine Sand per cent.	Silt per cent.	Clay per cent.	pH	Nitrogen per cent.
620	29·88	26·29	21·03	22·91	6·46	0·230

This soil is more loamy in character, has a good nitrogen figure and is less acid than previous samples.

Sample 621 is a surface sample (2 to 4 inches) taken from a shallow cutting at Vunimalu a low hill near the floor of the Dreketi River Valley, adjacent to a native garden where bananas, dalo, etc., were growing well. Profile examination showed soil was dark brown in colour to 12 to 18 inches changing to light reddish brown to grey brown at 4 feet at which depth decomposing pebbles are encountered. At 6 feet the colour changes again to reddish brown. Definite horizons were not encountered by field observation.

Sample 622 was taken at 18 to 20 inches depth below 621.

Soil No.	Coarse Sand per cent.	Fine Sand per cent.	Silt per cent.	Clay per cent.	pH	Nitrogen per cent.
621	6·24	9·52	12·96	71·21	5·38	0·478
622	5·79	8·46	10·02	73·48	4·84	0·114

As with previous samples 621 is an acid heavy clay with extremely high nitrogen content. The immediate sub-surface soil is slightly more clayey and more acid.

Sample 623 is a surface sample from the floor of the valley about ¼ mile to south of the mill. The topography is flat, drainage somewhat impeded and had been cultivated by Fijians for seven years for dalo and other food crops and at time of sampling was under low grass, with some weed (Solanum and guava), for grazing. Profile characteristics were not observed.

Sample 624 is a surface sample from a cultivated field in a Chinese market garden to the north of and adjacent to the mill. The topography is flat on the valley floor and the drainage though probably impeded originally, is now artificially drained and has been under vegetable cultivation for five years. Manuring has not been practised and adjacent flats carry guava and coarse grass. The area was probably timbered 10 to 15 years ago. Profile characteristics were not observed.

Sample 625 is a composite surface sample from cultivated land on Fong Lee's market garden on the Nadarivatu–Navai road. The soil is brown in colour with which reddish sub-soil has become incorporated in some places by ploughing. Vegetables have been raised with moderate success for the past four to five years and it is believed that dressings of blood and bone fertilizers have been given although no certain information was available. Profile characteristics were not observed but adjoining slopes appear to be "talai siga".

Sample 627 was a subsoil sample taken at 18 to 20 inches below 625.

Soil No.	Coarse Sand per cent.	Fine Sand per cent.	Silt per cent.	Clay per cent.	pH	Nitrogen per cent.
623	7·79	16·05	32·03	51·99	6·08	0·302
624	4·53	19·03	22·59	58·32	5·60	0·112
625	6·58	12·22	19·33	61·80	4·40	0·148
627	10·94	23·98	27·19	37·58	5·13	0·021

Samples 623, 624 and 625 are somewhat similar in composition and are clays of somewhat lower clay content to that observed in previous samples. Sample 625 is highly acid and 623 and 624 are somewhat less so. Sample 623 has a higher nitrogen content than 624 and 625. This may be due to intensive cultivation in the case of 624 and 625 without fertilizer addition in sufficient amounts. These soils form a separate group to those already discussed and in terms of 627 appear to be less clayey with depth.

Sample No. 626 is a surface sample taken from the road cutting on the Government Station at Nadarivatu. It is a very shallow brown-red surface soil (4 inches) changing to red subsoil with reddish-yellow decomposed rock at depths ranging from 6 feet to 10 feet below this.

Sample No. 451. This is a surface sample taken in 1939 from a similar locality to No. 626 in a cutting near the Government Rest House at Nadarivatu.

Soil No.	Coarse Sand per cent.	Fine Sand per cent.	Silt per cent.	Clay per cent.	pH	Nitrogen per cent.
626	6·96	15·45	23·21	54·54	5·62	0·340
451	6·84	13·39	39·33	40·38	5·22	..

Both samples are somewhat similar in mechanical composition to 623 and 624 and are moderately acid silty-clay-loams.

Samples 449 and 450. These samples were taken during a profile examination on the slope of Mt. Lomalagi near the summit. Vegetation consisted of tall scrub and secondary forest growth with ferns and grasses. Parent material is basaltic in nature. Soil colour is brown black to chocolate with much organic matter on top 3 to 5 inches. Soil depth was quite considerable in places considering the slope, with loamy texture loosely compacted and crumb structure. The profile showed no definite horizons.

The typical profile description was as follows:—½ inch of forest *duff followed by 1 inch chocolate brown loamy, humus stained layer, crumb structure, containing earth-worms and followed by 3 feet of lightly coloured chocolate loamy clay followed by decompsing volcanic rock to 18 feet.

* Duff means decomposed forest litter in process of humification.

Soil No.	Coarse Sand per cent.	Fine Sand per cent.	Silt per cent.	Clay per cent.	pH
449 1st foot	7·45	13·40	32·05	47·01	4·94
450 2nd foot	7·89	18·68	14·98	58·51	4·80

Additional Chemical Data.

The total P_2O_5 as determined by the usual hydrochloric acid extraction technique on three slelected soils was as follows:—

Soil No.	P_2O_5
615	0·179 per cent.
617	0·226 ,,
626	0·215 ,,

These soils, which are considered to be fairly representative of the area, are well supplied with total P_2O_5.

The total exchangeable bases and exchangeable calcium as milligram equivalents per 100 grams of soil were determined by the N/2 acetic acid extraction technique on six soils with the following results:—

Soil No.	Total Ex. bases mlg/100 grms.	Ex. Calcium mlg/100 grms.
612	2·03 per cent	1·66 per cent.
617	4·35 ,,	3·55 ,,
615	14·85 ,,	12·35
621	13·39 ,,	12·67
620	23·81 ,,	16·91
623	22·64 ,,	15·36

Samples 612 and 617 are low in total exchangeable bases and exchangeable calcium; samples 615 and 621 are moderately well supplied and samples 620 and 623 are well supplied.

General Remarks.

From a consideration of mechanical composition and profile data available, five series of soils are represented:—

Series 1.—Types 617, 615, 612. These soils are heavy clays overlying a sub-soil of higher clay content. Field conditions suggest a lighter texture than indicated by the mechanical analysis.

Series 2.—Types 613, 621. These soils are heavy clays, have slightly higher clay contents than Series 1 and overly a subsoil of similar clay content. Field conditions suggest a silty-clay rather than a heavy clay.

Series 3.—Types 623, 624, 625, 626 are clays, medium to heavy, overlying a subsoil which drops considerably in clay content. From field observations these soils appear lighter than the mechanical analyses indicates.

Series 4.—Type 449. This soil is a heavy loam immediately overlying a clay subsoil. Field conditions indicate a loam texture.

Series 5.—Type 620. This soil is a medium loam and is representative of the thin valley-side soils.

Although a strict soil survey of the area was not carried out and profile information is meagre, the following broad generalizations emerge from the filed and chemical information recorded in this paper:—

(1) The soils of the region are youthful as indicated by poorly developed profile.

(2) Topographic features have to a large extent modified the general trend of soil formation characteristic of the climate, geology and vegetation of the region.

(3) Bush clearing has still further modified the general trend and there is some evidence of soil degradation following on cultivation without conservation.

The few profiles which have been studied appear to be somewhat similar in general characteristics but are immature, vary in depths as the hills are ascended and the colour variations from light brown to reds and evidence of impeded drainage in the flats suggest a catena association. However, further field work will be required before the soil pattern can be more completely defined.

Agricultural Potentialities.

The area comprises some fifteen thousand acres and almost the whole of it is, or has been until recently, heavily timbered and is being exploited by the Fiji Kauri Timber Company. The steep topography limits the development of the whole of this area for mixed farming and at the most it is considered that some 4,000 acres could be regarded as suitable for settlement provided that sound management schemes directed to fertility conservation were instituted. This would require experimental work in the region.

There is a mistaken belief that cleared forest land in the tropics is rich but experience in other parts of the tropics has shown that removal of the forest cover from certain tropical soils leads to rapid deterioration unless sound management, involving rotation of crops and the use of green manure, organic matter and artificial fertilizers, is developed.

The forest cover is the end of a series of plant–soil associations involving a complete working over of the soil and the establishment of a dynamic equilibrium between the soil and rain forest cover. This means simply, that soil fertility is maintained by the forest itself, i.e. by the decomposition of the leaves and other organic matter which reach the forest floor, and its conversion into humus. Such soils if cleared of forest may give good crops for periods controlled by the available supply of soil humus but when this is used up ruin may overtake the venture.

The chemical analyses show that in general many of these soils are still well charged with humus. This is indicated by the high nitrogen figures and the field assessment of texture; however, the nitrogen figures on certain cultivated areas referred to previously are somewhat lower than the figures for virgin soils. This is indicative of deterioration. Furthermore, field observations indicate that there is much "talai siga" country in areas which were once covered with rain forest.

The chemical figures indicate that soil conditions are extremely acid in most areas necessitating coral sand dressings of some 8 to 10 tons per acre. Coral sand would also greatly improve the mechanical conditions of these soils.

A general assessment of the area indicates that in the first instance approximately 1,000 to 1,500 acres of gently rolling country and the valley floors could be utilized for mixed farming provided that a scheme of management should include rotations involving green manures, forage crops and grazing. Fertility should also be maintained by the application of coral sand and artificial fertilizers. If success is attained the grassing of the steeper slopes for grazing could be studied.

ENTOMOLOGICAL NOTES.

By

R. J. A. W. LEVER, B.Sc., D.I.C., A.I.C.T.A., F.L.S.,

1. THE PINEAPPLE BEETLE BORER AND ITS ORIGINAL FOOD PLANT.

THE pineapple beetle borer, *Anomocaulus fulvovestitus* Frm., was first recorded in the Colony in 1914 from Natewa Bay, Vanua Levu, by Jepson(1) who referred to it correctly as " a small species of rhinoceros beetle " but neither named it nor referred to it in subsequent annual reports. It was not mentioned again till 1940 when the writer referred to it(2) as the pest most capable of causing severe damage to pineapples. In view of the likely return to planting and canning of pineapples both in north-western Viti Levu and Ovalau it is hoped that the following notes on this beetle will be of some interest, if only for the discontinuous records of its status as a pest.

The beetle ranges in colour from light to dark brown and from two-thirds to an inch in length. The earliest specimen in the Divisional collection was taken at Levuka, Ovalau, by Simmonds in May 1922, but no details at all are available about its capture. Two more were taken by him in 1934, one at light in Suva and the other at Navuso, attacking the centre of pineapple plants—the first record as a pineapple pest for twenty years. There was a record of damage to pineapple plants near Lautoka in 1938 but during the period 1939 to 1944 *Anomocaulus* was found only at light, understandable enough as pineapple cultivation dropped almost to zero during the war.

Carter in 1942 dealing with his 1937–38 visit stated (3) that damage was serious and *Anomocaulus* was instanced as being the economic pest of pineapples nearest to Hawaii but not yet introduced into those islands.

In 1945 extensive damage was noted on leaf bases of the larger screw pine (*Pandanus tectorius* Sol. Rumph.) or " vadra " used by Fijians for thatching and the smaller *P. thurstonii* Wright or " voivoi " which provides mats and fans. Examination of plants both in Suva and Namaka showed the holes to be caused by *Anomocaulus* which being a Dynastid is a rhinoceros beetle though not closely related to the coconut rhinoceros bettle, *Oryctes rhinoceros* L. Whether or not the sharply serrated edges had previously discouraged close examination of the unfolded leaves is not apparent but it is remarkable that the first record of this beetle on screw pines had to wait till 1945.

Even more unusual is its distribution in the Colony as during November 1945 it was found doing quite serious damage to " vadra " near Tubou, Lakeba and its characteristic injury was also seen in other islands of the Lau Group, viz. Vanuabalavu, Cicia and Moala which proves, with Jepson's 1914 record from Vanua Levu, that *Anomocaulus* occurs throughout Fiji with *Pandanus* as its original food plant.

Owing to the closely wrapped leaves with their sharp spines it would be difficult to control this insect either with ordinary spraying or hand collection but it is suggested that it would be prone to treatment with DDT or 666 when these become cheap enough to use for plants other than vegetable garden or estate crops.

Damage was also seen on " vadra " at Lakeba caused by the weevil *Diathetes pandanæ* Zimm. but grubs only were obtained.

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(3) Carter, W. 1942—*Jrnl. Econ. Entom.*, Vol. 35, No. 1, p. 15.

2. ANTS COMPOSING BAT GUANO FROM CAVES.

In dealing with insects associated with bat guano the writer (1) previously mentioned that this substance was largely composed of remains of ants and wing-covers of beetles. A sample from the Tamavua cave was recently examined by a world authority on ants, Mr. H. Donisthorpe of the British Museum (Natural History), London, with the following results. The material consisted of heads of soldiers and workers of *Camponotus* (*Colobopsis*) *rufifrons*, F. Smith and *C.* (*C.*) *maudella* Mann., besides other ant fragments which could not be identified.

The second ant named was described from material collected in 1916–17 by Dr. Mann (2), the type locality being Waiyanitu, a tributary of the River Navua, where it was said to be abundant.

It is of interest to note that live specimens of the common cockroach, *Periplaneta americana* L. were found partially buried in and probably feeding on the guano in caves both at Sautabu, Sigatoka and at Delaiono, Lakeba Island in Lau, showing how thoroughly this introduced insect has established itself in every environment in even the most isolated islands of the Colony.

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3. FURTHER NOTES ON THE *AEDES* OR " TIGER " MOSQUITOES.

In the issue for March 1944 (1) some information was given about the breeding places of the filarial mosquito, *Aëdes scutellaris* Wlk. *pseudoscutellaris* Theo. and the dengue mosquito, *A. aegypti* L. and this is now amplified.

In dealing with the former Dr. Bahr (now Sir Patrick Manson-Bahr) wrote of it in 1910 (2) that " its breeding ground is fresh, or, preferably brackish water such as occurs in the creeks to be found running through every Fijian village, especially in the eastern islands " (i.e. Lau). He illustrates this with a photograph (XVII) of such a creek at Lomaloma, Vanuabalavu, the picture however being labelled " probable main breeding place of *Stegomyia pseudoscutellaris*." In his appendix XXXIII he states (2a) that he " almost entirely failed" to breed it from fresh water in such places. These observations on the water-places chosen by the filarial mosquito have puzzled the writer for some years past but it was not till October 1945 that an opportunity arose of reaching the Lau group. At both Lomaloma, Vanuabalavu and Tubou, Lakeba the writer failed to take *pseudoscutellaris* in the creeks running through native coconut groves where the mosquitoes themselves swarmed. Larvæ were however, easily found in the fallen boat-shaped coconut spathes and it is suggested that these containers are usually chosen when tree holes and split coconut husks (the usual non-domestic sites) are not available.

These observations are borne out by Buxton's work in Samoa where no less than fourteen types of breeding places are listed (3), none comprising running water. Of them, six were found by the writer in Lau to have *pseudoscutellaris* larvæ, viz. coconut husks, tree rot-holes, depressions in coral (Buxton gives holes in lava), drains, crab holes, and tins besides the

coconut spathes already mentioned. Unpublished reports of work by American and Australian entomologists during the war all confirm this mosquito to be essentially a breeder in small containers, less often in small collections of standing water but never in the running creeks recorded at Vanuabalavu (1).

The writer was bitten by *pseudoscutellaris* before noon when well inside a cave at Delaiono, Lakeba: water in the top of a hollowed-out stalagmite did not contain any larvæ. Small bats (*Emballonura* sp.) were present in large numbers on the walls of the cave and may have provided blood meals.

This opportunity is taken of drawing attention to the report of the Anti-Mosquito Campaign of 1920 (4) in which reference is made to the occurrence together in Suva of the larvæ of the two mosquitoes under discussion with those of *Culex fatigans* Wied. in among other places, taro swamps and probably in rice swamps. These sites have never yielded at one time these three species of larvæ to the writer or his assitant mosquito inspectors though ponds and pools are occasionally chosen for oviposition by both species of *Aëdes* and fairly frequently by *Culex fatigans*.

So far as the distribution in the Colony of *A. aegypti L.* is concerned it is placed on record that it was not taken in any of the Lau group visited in October and November 1945, (Naitauba, Kanacea, Mago, Vanuabalavu, Susui, Cicia, Lakeba and Vanuavatu. Paine (5) referred to *aegypti* as being common " in most of the larger towns in Fiji " and also at Vuna, Taveuni and it will be interesting to see when it is first recorded from Lomaloma, Vanuabalavu, the main calling place for vessels in the Lau group.

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(2a) Ditto—p. 188.
(3) Buxton, P. 1927—" Researches in Polynesia and Melanesia." London School of Hygiene and Tropical Medicine, p. 106.
(4) Journal of Legislative Council, Fiji 1925—Council Paper No. 11, Enclosure (1) of 1920.
(5) Paine, R. W., 1935—"An Introduction to the Mosquitoes of Fiji ", p. 14. (Reprinted 1943, pp. 18–19.)

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4. THE HUMAN AND DOG FLEAS IN THE PACIFIC.

The flea found in and under houses in Fiji invariably turns out to be the cat and dog flea, *Ctenocephalides felis* (Bouché). In a recent article in the local press (1) headed " Insect Invasion Repelled ", the common local flea was referred to as *Pulex irritans*. Although it is fully recognized that the article was intended only for popular consumption it is worth drawing attention to it as a scientific identification of doubtful accuracy was given; further, the article might easily be reprinted in the Australian press.

Pulex irritans is the common human flea in Europe, North America and Africa but it is scarce in many Pacific Islands. Also, neither Jepson (2) nor Thompson (3) record it from Fiji nor has the writer seen any local specimens, the most abundant being the dog flea with the plague flea, *Xenopsylla cheopis* Rothschild, rather scarce.

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(2) Jepson, F. P. 1911—Council Paper No. 25, Fiji, p. 28.
(3) Thompson, G. B.—1937—*Entomologists' Monthly Magazine*, Vol. 73, p. 186.

5. THE INDIAN ROSE BEETLE, *ADORETUS VERSUTUS* HAR.

This destructive beetle has been for nearly forty years referred to in Fiji as the Japanese rose beetle but as our *Adoretus* does not occur in Japan and moreover the name Japanese beetle is accepted by entomologists as standing for quite another insect (*Popillia japonica*), it is suggested that the substitution of the name Indian rose beetle in place of Japanese rose beetle for our introduced *Adoretus* may be adopted.

1. Nomenclature.

This beetle in 1858 was described by Boheman as *Adoretus vestitus* but this name being preoccupied it had in 1869 to be sunk in favour of *A. versutus* Harold which still stands. Nonfried in 1891 had used the synonym *vitiensis* and this will be referred to later in another connexion.

Knowles (1), in the first local mention of this insect in 1906, referred to it as *Adoretus umbrosus* var. *tenuimaculatus* and Jepson retained this name until 1917 when he used *A. tenuimaculatus* Waterh. (2) which is another Asiatic beetle introduced into Hawaii prior to 1908 and wrongly then thought to be identical with the beetle introduced into Fiji. Simmonds continued with this name as late as 1922 (3) although Veitch had shown three years earlier that *A. versutus* was correct (4).

2. Distribution.

A useful paper by Ohaus (5) gives the original home as India and Ceylon from which it was introduced in soil to Java, Fiji, Tonga and Samoa in the east and to Seychelles, Mauritius and St. Helena in the west. To this should be added Madagascar where it was referred to in 1917 (6) as being parasitised by a Scoliid wasp. In Fiji, as stated above, the first record is for 1906 (1) though Jepson (7) suggested its entry was comparatively recently prior to 1911 from Hawaii which is clearly incorrect as the beetle does not occur in those islands. Further, one is able to show that it must have been in the Colony at least since the 'nineties as Nonfried's paper, referred to above, described it in 1891 as *vitiensis* (8) showing he had by then already received specimens from Fiji. It is therefore reasonable to suppose this insect arrived here in the late 'eighties or perhaps very early 'nineties as larvæ in pot plants or soil brought by immigrants of whom over 1,100 disembarked in 1890 (9). From Fiji it was carried in the course of years by normal shipping to Samoa (prior to 1914) and to Tonga. Lakeba, Lau is the only island in Fiji in which the writer has not seen roses attacked by this beetle.

3. Food Plants and Damage.

Rose and cocoa leaves are the most usual plants damaged by this nocturnal beetle and it is interesting to see from records the fluctuation of its intensity. Knowles' earliest reference (1a) in 1906, already referred to, recorded that even then much supplying of cocoa plants was necessary owing to damage by this beetle yet Jepson found damage to young cacao on Vanua Levu in 1915 to be "too infinitesimal to call for any treatment" (10) but next year cocoa was so badly damaged that the beetles were difficult to deal with by artificial means (2). This held good in 1916 (11) and 1917, where newly planted areas suffered disastrously (12) and again in 1918 when young plants were sometimes killed outright (13) by defoliation. Veitch and Greenwood added sugar cane (14), *Bougainvillea spectabilis* Willd. and *Poinciana regia* Boj.(15). However, the former writer stated earlier (4) that *Adoretus* was of slight economic importance in the cane fields and added guava and acacias as plants attacked. Simmonds' record of *Acalypha* (3) was followed by Greenwood's *Lagerstræmia indica* L., *Alphitonia zizyphoides* A. Gray (16) and *Zinnia elegans* Jacq.(17) and the writer has found defoliation of vau (*Hibiscus tiliaceus* L.) to be common.

4. Life History.

Jepson (7) appears to have been the first to tackle the life history which he made to average 34 days, viz. seven days for the eggs, 17 for the larvæ and 10 for the pupæ. Only the egg and pupal periods were found by the writer during February and March 1945, to correspond with these figures. Veitch's figures of 12–14 days for the incubation period (18) were presumably obtained under cold season conditions at Lautoka which is very slightly cooler and less humid than Suva. Jepson's larval period of 17 days is not confirmed by the writer who has kept healthy larvæ in moist soil with grass roots for periods up to four months and this only confirms Hawaiian experiences where development of the grub alone takes 120–130 days and egg to adult occupies 148–184 days (19). Veitch (18) cautiously states the grubs "eventually pupate," giving no time.

Unlike the beetle, the white fleshy grubs are root eaters, chiefly of grass, and spend their whole life underground as is, of course, the case with the oval white eggs and resting pupal stages. There is however some vertical movement in the soil, the grubs going deeper in persistent dry weather and coming nearer the surface when it is wet. As is well known, the beetle is strictly nocturnal, coming out after dark from its day resting places underground to attack leaves of roses, zinnia, cocoa, sugar cane and vau.

5. Control in the Past.

Jepson dealt with handpicking by light at night and also recommended building split bamboo fences around rose bushes or erecting a light framework covered with cheese cloth (7). For young cocoa he similarly suggested an 18 inch high fence of one inch wide split bamboos which diverted the flying beetles from the leaves (11). Spraying and dusting with Paris green and flowers of sulphur were both proved by Jepson to be ineffectual and this has been confirmed by the writer in Suva using lead arsenate.

Two species of parasitic fungi (*Sterigmatomycosis feruginosis* and *Botrytis*) were imported from Honolulu in 1910 but distribution of the spores did not prove effective in controlling the beetles (2). Biological control by parasitic insects started in 1917 when the Scoliid wasp *Campsomeris marginella modesta* Smith (then called *Scolia manilæ* Ashm.) was introduced from Hawaii by the Colonial Sugar Refining Co., primarily for use against the related sugar cane beetles *Rhopœa* spp. (18).

6. Control To-day.

There the matter of control remained till supplies of D.D.T. became available late this year. It was realized that routine application of arsenicals were unsatisfactory (at least in the Suva peninsula with its rainfall averaging 120 inches per year) and so experiments were begun with D.D.T. on rose trees as these were the most convenient plants.

Dusting was first carried out using colloidal sulphur and 3 per cent D.D.T. which were found to have a much more repellent effect than the sulphur alone. This was repeated using musty flour and 3 per cent D.D.T. with equally satisfactory results; undusted bushes were used for controls in this case as flour alone was clearly nontoxic. Although subsequent rain converted the dust into a somewhat unsightly paste on the leaves, it kept away the beetles. As a matter of interest, two sets of tests were nullified through very heavy rainfall, 5·61 and 5·44 inches being recorded in 24 hours respectively on 8th October and 4th November, these precipitations naturally removing all traces of the dust and the trials were disregarded.

Although further work with this insecticide is in progress it is suggested that enough has been done already to warrant publication and to show that D.D.T. should be able to check this beetle so that rose bushes throughout the Colony may again appear as they must have done in the 'eighties and as they do to-day on Lakeba.

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(1*a*) Ditto., p. 3.
(2) Jepson, F. P. 1917—*Ibid.* for 1916. Council Paper No. 107, pp. 19 and 22.
(3) Simmonds, H. W. 1922—Agric. Circ. Fiji, Vol. 3, No. 2, p. 23.
(4) Veitch, R. 1919—*Bull. Ent. Resch.* Vol. 10, Pt. 1, p. 29.
(5) Ohaus, F. 1935—Occsl. Paper, Bishop Museum, Honolulu, Vol. 11, No. 2, p. 7.
(6) d'Emmerez de Charmoy, D. 1917—Dept. Agric. Mauritius, September.
(7) Jepson, F. P. 1911—Council Paper No. 25, Fiji, pp. 54 and 59.
(8) Nonfreid, A. F. 1891—*Deut. Ent. Ztschr.*, Dresden, Vol. 35, p. 268.
(9) Immigration Statistics for Colony of Fiji for 1890.
(10) Jepson, F. P. 1915—Dept. of Agriculture Fiji, Pamphlet No. 16, p. 4.
(11) Knowles, C. H. 1916—Pamphlet No. 17, p. 4.
(12) Ditto 1918—Annual Report for 1917. C.P. No. 60, p. 10.
(13) Jepson, F. P. 1919—*Ibed.* for 1918. C.P. No. 32, p. 13.
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(15) Ditto 1924—*Ibid.* Vol. 49, 2, p. 157.
(16) Greenwood, W. 1929—*Ibid.* Vol. 54, 4, p. 347.
(17) Ditto 1940—*Ibid.* Vol. 65, 3 & 4, p. 214.
(18) Veitch, R. 1922—Agr. Rpt. No. 5 Col. Sugar Refining Co., Sydney. March, p. 12.
(19) Van Zwaluwenberg, R. H. 1937—*Hawaiian Planters' Record*, Vol. 41, No. 1, p. 30.

666 OR GAMMEXANE INSECTICIDE.

In the June issue of the *Journal* (p. 49) an extract appeared on the above insecticide, giving only very brief details. Until quite recently this substance was still on the " restricted " list from which it has since been removed and further information can therefore now be released.

By composition it is benzene hexachloride, the molecule having six atoms each of carbon, hydrogen and chlorine, hence the symbol 666. (As a matter of interest the material 606, used for quite another purpose, was given these numerals to represent the number of trials made before it was discovered: this also happened with the well-known sugar cane variety POJ 2878 evolved in Java after that number of experiments).

666 is said to be slightly more poisonous to insects than the now familiar DDT, is claimed to be harmless to both animal and plant life and is also cheap to make—in other words it really is the ideal insecticide. Its arrival in 1942 coincided approximately with that of DDT but it was achieved by Imperial Chemical Industry after eight years work in England specifically directed to finding such a substance and not by a rediscovery of something overlooked for seventy odd years as was the case with DDT.

With Malaya not available for derris production, some cheap substance had to be found for control of two serious war-time pests, the wireworm in wheat and especially the flea-beetle in turnip and mangold; good results were achieved against both these insects and also against locusts in Africa and the grain weevil in England.

666 is a sand-coloured powder containing at least four ingredients, one of which (the gamma) has most of the insecticidal properties, hence the alternative name Gammexane.

When released for civilan use it should, therefore, be of great value to the farmer, orchardist and livestock owner as it kills sheep tick and house-flies as well as mosquitoes, bed bugs and lice and appears to be quite harmless to man.

—R.J.A.W.L.

THE " BLUE " GRASSES IN FIJI.

By

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THE name " blue grass " is usually reserved for species of *Poa*, an important genus of forage grasses in the temperate and cool regions of both hemispheres. The annual blue grass and Kentucky blue grass (1) are well known examples. None of these occur in Fiji where the name is commonly applied to at least six different grasses which are briefly described below. Three belong to the genus *Dicanthium* and one each to the genera *Amphilopis*, *Andropogon* and *Ischaemum*. It will be noted that with the exception of the last named all of these plants are closely related and are by some authorities grouped together in the one genus *Andropogon* whose members are often referred to as the " beard grasses."

The following species have been recorded as occurring in Fiji:—

1. *Dicanthium annulatum* Stapf., first recorded at Lautoka in 1927.
2. *Dicanthium sericeum* (R. Br.) Stapf., occurrence in Fiji doubtful.
3. *Dicanthium caricosum* A. Camus, introduced at Nasinu 1906 and later recorded at Labasa in 1927.
4. *Dicanthium nodosum* Willem., collected in Suva 1936.
5. *Ischaemum aristatum* Linn., collected at Labasa in 1919 and recorded in 1927.
6. *Amphilophis glabra* (Roxb.) Stapf. first recorded in 1927.
7. *Andropogon pertusus* (L) Willd., first noticed 1930, first recorded in 1944.

All of these are characterized by blue-green foliage and by the inflorescencees or flower heads consisting of one, two or more hairy racemes borne on fairly long culms or stems.

The *Dicanthiums* are generally known in the northern hemisphere as beard grasses, in Australia as blue grasses. They are widely distributed in the warmer parts of the world. They occur in Fiji as weeds of road margins, drains and cuttings in Suva and throughout the greater part of Viti Levu and parts of Vanua Levu. They are known locally as " Nadi," " Nawai," or " Malolo " grass, and with the exception of one species appear to have been introduced accidentally at various times during the past forty years. They have become popular with pastoralists during the past ten years and two species are sown to permanent pastures, especially in the dry areas at Nadi, Sigatoka, Ba and Ra. One or more species have also been successfully established on hill pastures on dairy farms in the Tailevu district. They are generally palatable to stock when young but in the late summer months become tough and somewhat coarse.

The species referred to in the present article may be determined by reference to the following key:—

A. Racemes usually three to six; spikelets slightly overlapping, the pedicels usually partly visible:—

Racemes on short peduncles, loosely digitate, hairy but not long silky .. .. 1. *D. annulatum*

Racemes sesaile, densely digitate, long silky .. 2. *D. sericeum*

B. Racemes usually one, sometimes two or three, spikelets closely overlapping, the pedicels hidden:—

Culms glabrous below raceme .. .. .. 3. *D. caricosum*

Culms pubescent below racemes .. .. .. 4. *D. nodosum*

1. *Dicanthium annulatum* Stapf. (*Andropogon annulatus* Forsk).—Sometimes called Angleton grass, this plant is a native of Asia and Africa, originally described from Egypt. It was first recorded locally by Greenwood from

Lautoka in 1927 (2); and Smith in 1924 recorded it as a roadside weed along the shore in the vicinity of Suva (3). There are specimens in the Department of Agriculture collected at Korovou, Suva, by C. R. Turbet in 1924, and the plant has since been collected from a number of localities on the Suva peninsula: Walu Bay, No. 2024, June 1939; Knollys Street, No. 2899, May 1939; and Tamavua, No. 2556, May 1940.

It is a fairly robust perennial, one to three feet tall; stems erect from a spreading base, tough and slender, purplish and with long silky hairs at the joints: leaves two to five inches long, $\frac{1}{8}$ to $\frac{1}{4}$ inch wide, tapering to a fine point; flowering heads three to nine rarely fewer, spreading purplish brown in colour, one to two and a half inches long, sparsely covered with short hairs and with soft bristles. Locally it forms a dense turf of moderately fine foliage, and is altogether a smaller plant than the other common species. It does not appear to have become established in pastures.

2. *Dicanthium sericeum* (R. Br.) Stapf. (*Andropogon sericens* R. Br.) also known as Australian blue grass is an erect perennial, one to three feet tall, conspicuously bluish green stem, bent at the base, long bearded at the joints: leaves 6 to 18 inches long, $\frac{1}{8}$ to $\frac{1}{4}$ inches wide; flowering heads with two to five branches or racemes, one to two inches long, these being usually close together forming compact heads, covered with long silky hairs and bearing long, soft, twisted, reddish brown bristles.

This plant is a native of Australia, where it is said to be one of the most palatable of the native grasses, (4). In Hawaii, where it is abundant in lower pastures of the dry regions on the island of Maui, Whitney and others (5) state that it is very palatable, hardy and drought-resistant, producing considerable forage and proving very valuable in dry areas.

No records of the introduction of this species to Fiji can be found.

Specimens collected at Korovou near Suva in 1924, by C. R. Turbet, were referred to this species at the time; but subsequently have been determined as those of *D. annulatum*. The presence of this species in Fiji is doubtful although it is often claimed that it does occur. It is included here as it may have escaped notice and as it is of good repute as a fodder plant.

3. *Dicanthium caricosum* A. Camus (*Andropogon caricosus* L.) is a native of India introduced to Fiji about 1906 by the Department of Agriculture under the name Antigua hay grass. It is now widespread in the dry zone of Viti Levu as a pasture grass under the local name " Nawai " grass. It is common along roadsides in Ba and Ra provinces and in cultivation at Yaqara.

It was recorded in Labasa by Greenwood in 1927 as fairly common in moist places (l.c.) and has been collected from many different localities in recent years.

The plant is a decumbent freely branched low perennial, culms one to three feet high, joints glabrous; leaf blades flat $1\frac{1}{2}$ to 8 inches long, $\frac{1}{8}$ to $\frac{1}{4}$ inch wide; flowering heads of solitary or paired racemes, 1 to 4 inches long, wavy: spikelets falling entire at maturity, two-flowered, awns slender, twisted and bent.

It forms a close turf and is highly regarded by pastoralists in the dry areas; it is palatable to stock and its cultivation is being extended in several districts where its ability to form close weed-resistant swards under local grazing conditions has attracted attention. This species appears to be well suited for dry zone pastures and its further establishment to be most desirable.

Recorded specimens are: Viti Levu, Nadi, No. 2052 (Sept. 1939); Lautoka No. 2520 (Jan. 1940); Vanua Levu, Labasa No. 5740 (July 1945).

4. *Dicanthium nodosum* Willem. (*Andropogon nodosus* (Willem.) Nash) is also known locally as Nawai grass. It is common in waste places in the Suva areas whence seed has been collected and distributed to other parts of Viti Levu.

This plant is a native of tropical Asia and it may have been introduced together with the preceding species with which it is often to be found growing. It was introduced to Hawaii from the West Indies in 1911 by G. P. Wilder and is known there as Wilder grass. It is stated to grow well in many places on Maui and Oahu but has assumed little importance in pastures.

It is similar to *D. caricosum*; and Hitchcock ([6]) says it is possibly only a variety of that species. It is considerably larger and taller, erect, two to four feet high, culms white pubescent at the nodes with leaves four to eight inches long, narrow, flat, the young leaves covered with hairs; flowering heads on long stems, two to five branched at the top, the culm and peduncles densely pubescent below the racemes. The awns are spreading, brown, twisted, about half inch long.

In some specimens the pubescence at the nodes is very much reduced and hardly discernible.

This appears to be the first record of its occurrence in Fiji although it has been collected a number of times from different localities.

Ref. No. 1649, Viti Levu, Suva (June, 1939).

5. *Ischaemum aristatum* Linn. (*I. ciliare* Retz).—This species was first collected about 1919 by W. E. Lindsay at Tabacolo near Labasa and recorded by Summerhayes and Hubbard in 1927 ([7]). It has since been collected several times and is well established in the vicinity of Naduruloulou where its excellent growth on poor red-earth hill-slopes has been under observation since 1940.

It is a native of tropical Asia and Malaya but there is no information available as to how it reached the Colony.

This grass is a perennial with culms two to five feet high, nodes bearded with white hairs; the leaf-sheaths are loose and hairy, blades six to 12 inches long, shortly hairy; the flowering heads of two spreading spike-like racemes one and a half to two inches long, falling at maturity with the joints and stalks; spikelets paired, one sessile the other stalked, all alike, $\frac{1}{6}$ inch long, two-flowered, purplish, glabrous, awned, awns $\frac{1}{2}$ inch long.

This is a very distinct plant on account of the hairy leaf-sheaths, the bearded joints and the pair of spreading reddish purple racemes.

It is palatable to stock at all stages, forming when grazed a close leafy turf which holds well. Pastures of this species are very free from weeds possibly owing to its ability to flourish in the shade as well as on poor soil in the open field. It is easily propagated by cuttings or by seeds which mature in June.

For wet-zone hill pastures this species appears to be worthy of more extensive use. Some distribution has been made.

Locality: Viti Levu, Naduruloulou No. 2521 (Jan. 1940); Vanua Levu, Labasa No. 5741 (July 1945).

6. *Amphilophis glabra* Roxb., Stapf. (*Andropogon glaber* Roxb.).—Known locally as " native blue grass " or " Caboni grass ", this plant is very common in the drier parts of the Colony and is widely distributed in tropical Asia, Africa, NE. Australia and Polynesia.

It is an erect tufted perennial, culms to over three feet high; the leaf-blades are narrow, often more than 12 inches long, $\frac{1}{6}$ to $\frac{1}{3}$ inch wide, finely pointed with rough margins. Racemes three or more, $\frac{1}{2}$ to $1\frac{1}{2}$ inches long,

in a panicle four to nine inches long. Spikelets paired, $\frac{1}{12}$ to $\frac{1}{8}$ inch long, lower glume of sessile spikelets pitted; awn $\frac{1}{4}$ to $\frac{1}{2}$ inch long: stalked spikelet $\frac{1}{8}$ inch long, awnless.

McTaggart (8), records a Rhodesian strain of this grass as an outstanding introduction which under experimental conditions in Queensland significantly outyielded all other grasses. Locally, owing to its ability to withstand dry periods better than other available species this grass is no doubt a useful constituent of grazing land in the dry zones; but where *Dicanthium* species are available it is not highly regarded by stockmen. Stuchbury writing in 1937 states that this grass " which forms the foundation of the pasture in the Yaqara area gives excellent young growth, but it tends to become rank in the dry season ".(9)

Localities specifically recorded are: Viti Levu, Nadroga, No. 2877; Penang, Ra, No. 3029; Nananu-i-cake, No. 2749: Vanua Levu, Labasa, No. 5772.

7. *Andropogon pertusus* (L.) Willd., which belongs to a different section of the genus from *Dicanthium* has recently been recorded and is therefore mentioned here.

This grass which is a native of India was first noticed near Lautoka about 1930 by Greenwood (7) who says the plants " spread out from the base and form flat tussocks, seeding profusely. Stock do not appear to like it ".

It is a perennial with culms ascending, branching, one to three feet high, the nodes bearded or glabrous; blades four to eight inches long $\frac{1}{8}$ inch wide, pubescent or nearly glabrous: racemes flabellately aggregate on a short axis, few to several one to two and a half inches long, villous: first glume with a pit or pinhole in the middle of the back; awn of sessile spikelet twice geniculate, brown, about $\frac{1}{2}$ inch long. This grass may be distinguished from the *Dicanthiums* by the fact that the lower pairs of spikelets are like the others and the first glume of the sessile spikelet is pitted on the back.

According to Hitchcock (l.c.) it has been introduced to the West Indies where it occurs on roadsides and open grassy places and where it is known as " Barbados sourgrass ".

A more slender form in the Virgin Islands is called " hurricane grass " and is said to be relished by stock and to make more satisfactory forage than does Barbados sourgrass.

Locality: Viti Levu, Lautoka, Greenwood 819; Yaqara, Parham 5584 (June 1945).

With a view to establishing the comparative nutritive value of the grasses described above, specimens have been collected for analysis and investigation by the Senior Chemist. The results of this work, which should be of the utmost interest to stockowners and farmers as giving reliable information for local conditions, will be published in a later issue of this *Journal*.

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AGRICULTURAL NOTES.

FACTORS AFFECTING RICE PRODUCTION WITH SPECIAL REFERENCE TO THE SOUTHERN AGRICULTURAL DIVISION, 1945.

By
B. E. PARHAM, M.A., Agricultural Officer, South,
and
J. C. S. SUCKLING, Dip. Dairying, Massey Coll., N.Z.

THE cultivation of rice is probably the most widespread agricultural activity in the Colony and local production is influenced by a wide range of climatic, soil and other factors. The total supply of padi is considerably below the Colony's requirement and accordingly it is of interest to examine the influence of local conditions on rice production.

The following table shows the number of growers and the areas planted in the 1944–45 season in the Southern Division:—

TABLE I.

PADI PRODUCTION—1944/45.

District.	Cane growers.		Others.		Varieties.
	Number.	Acres.	Number.	Acres.	
Ra	464	638	428	1,537	10
Tailevu North	..	..	167	512	14
Rewa	1,438	2,110	641	1,130	14
Navua	..	..	294	959	10
Total ..	1,902	2,748	1,530	4,138	..

The main fact which emerges from the above table is that the majority of rice growers in the Division are concerned with this crop mainly as a subsistence and not a cash one. There are few farmers who rely upon rice as their main crop or source of income and there is evidence in all districts to show that local conditions do not encourage farmers to extend their efforts much beyond that necessary to supply their own home requirements.

Even before the war many small farmers had no surplus for sale, nor would they sell their padi unless compelled to do so to pay their creditors (rent or store debts mainly) and then often at the risk of running themselves short of food later in the year.

The position may be illustrated by a consideration of the conditions prevailing in the Southern Division. Assuming that the average Indian family requires half a ton of rice (equals $\frac{3}{4}$ ton padi) annually for its own use and that many growers endeavour to hold a stock sufficient for 15–18 months it is clear that the growers (totalling 3,432) in the Division require a minimum of 3,000–3,600 tons of padi for their own use as food, reserve and seed (i.e. the yield from 4,000 to 4,800 acres). The balance of 1,000 to 1,600 tons may be regarded as available for sale and even so some of it is put on the market only when necessity demands. Compared with the requirements of the total rice consuming but non-producing population of

the Division this represents a total of approximately 800 tons short production of padi within the Division itself. It is doubtful if at any time the effective production of padi has been more than 70 per cent of the total requirements. At least 200 tons of padi are required annually for seed.

The explanation for this results in the growers' claim that it does not pay to produce rice under local conditions for sale as padi. (Although many of the problems affecting rice production in Fiji call for further investigation in the field, the following notes represent an attempt to establish the correctness of this claim in the light of observable facts.

The factors influencing the production of padi may be considered under two general headings namely (*a*) physical factors of climate, soil, land tenure, etc., and (*b*) biological factors of varieties, pests and diseases, etc. It is obvious that the former are more or less beyond the control of the cultivator whereas the latter are capable of at least partial control and adjustment.

Climatic conditions, principally rainfall distribution have a profound effect on the rice crop which in Fiji is grown in open fields without irrigation. The following table indicates the conditions under which the current crop has been produced in four different areas.

TABLE II.

RAINFALL 1944–45.

Month.	Ra.		Tailevu.		Rewa.		Navua.	
	Days.	Points.	Days.	Points.	Days.	Points.	Days.	Points.
1944.								
November ..	4	96	9	207	7	198	1	302
December ..	16	2,911	12	805	10	737	8	1,537
1945.								
January	14	1,523	16	1,028	15	967	6	783
February . ..	17	1,547	16	1,813	18	1,407	11	1,265
March	12	674	11	460	19	529	12	797
April	11	1,169	15	1,380	21	927	10	444
Total ..	74	7,920	79	5,693	98	4,765	48	5,128

The absence of adequate rain during the early part of the period (i.e. the rice planting season) is a limiting factor of some consequence. Seed beds are sown during November and December. Dry weather at this time adversely affects the growth of seedlings in the seed beds which are usually sited on higher land where watering is out of the question. Very dry weather may prevent the preparation of the fields and during the past three seasons has greatly delayed the main plantings, in some areas with serious results. Unless planted out before the end of January or mid-February at the latest, most varieties are unable to make sufficient growth to ensure good yields. The rice plant has a limited growth period so that there is little or no difference in the maturation date of plants transplanted late and those put out earlier. The former are obviously at a disadvantage and produce lower yields of grain and are usually more susceptible to adverse weather conditions. Many examples of unthrifty crops due to delayed planting out, dry weather and lack of sufficient labour at the critical period were to be seen at Navua and in Ra and elsewhere during the present season.

The rainfall figures for the Navua district for example show that during the period of 123 days from 1st October to 31st January the total number of days without rain was 104. There were three prolonged spells of drought from mid October to early December, from the 9th to the 26th December and throughout nearly the whole of January. It is during these dry periods that weeds flourish and occasion additional difficulties.

The optimum nursery period (seed to transplanting) is one month (maximum 40 days). The correct times for some of the principal wet zone varieties have been given by B. Ramnath (7); and observations made annually by the writer have confirmed the importance of adherence to these.

Although adverse climatic conditions do interfere with planting, bad weather is often merely used by growers as an excuse for their own neglect in planting out during the optimum period.

The periodicity of rainfall during the growing season is of the utmost importance in Fiji owing to the fact that irrigation and control of water is so rarely practised. Dry spells result in the drying up of surface water, which may attain a high temperature (112°F.), causing stagnation in the lower parts of the field with resultant uneveness of crop.

During the last three or four weeks of growth and particularly after the crop has headed, heavy rain showers cause lodging with loss of grain amounting to as much as 50 per cent. Winds at this time are also a source of crop damage. Control of water is of importance as small rice crops from which surface water has been removed at the correct stage are less liable to lodging.

Soil and Soil Management.

As the greater part of the rice crop is grown on low alluvial flats of the main and surrounding streams there is a marked uniformity in the type of soil devoted to this purpose. Typically these soils may be described as varying from loamy clays to silty clays. Departures from the use of such soils are often accompanied by crop failure at least so far as the main wet-land varieties are concerned. This may be seen where attempts are made to utilize rising ground (red earth soil) or extremely swampy areas where peat conditions exist and where drainage is impeded. C. H. Wright (8) in 1916 drew attention to the unsuitability of such soil for rice. His analysis of soil of the Sigasiga flat between Qaraniqio and Navua where rice crops had failed showed a loss on ignition amounting to 52·07 per cent. The upland variety, Sonacalif may be grown with success on the better drained alluvial flats, on the sandy loams of the Dawasamu district and on well drained forest soils at low elevations.

Drainage and Water Control.

Drainage and water control are of paramount importance, the retention of water by means of bunds or by closure of drains must be practised with discretion as stagnant water particularly during dry spells is fatal to the rice plant. The proper levelling of rice fields especially on new land is rarely carried out with the result that during dry spells the plants on the higher patches in the field suffer from lack of water and those in the isolated depressions often full of stagnant water, are affected by what may be described as root asphyxiation causing death of root tissues and depressed growth. The drying out of the surface soil also results in excessive weed growth.

No fertilizers are used in Fiji nor are any rotation crops grown in the fallows, which are usually used for stock grazing during the dry season (June to September). In Navua, within recent weeks a practice has developed of planting an out-of-season crop of the variety "New Guinea." This often involves too hasty soil preparation, too heavy a drain on soil fertility and interference with the drainage of the main crop.

Land Tenure.

Land tenure may be referred to briefly as it frequently influences the treatment to which the soil is subjected. There are many examples of wasteful land utilization due to the short and uncertain tenures which do not encourage the farmer to practice any system of soil conservation. Many rice growers use land on six or twelve months agreements, some pay excessive rents for short periods and there are cases where landlords have increased rents annually as tenants have improved their holdings or appear to have grown a good crop. Consequently land is prepared hurriedly, often the seed is sown broadcast, weeding is neglected and poor crops result.

The Occupation of the Growers.

Many rice growers are principally occupied with other interests. Canefarmers are responsible for a considerable area of rice which is grown on marginal and back lands as a subsidiary crop. The necessity for avoiding a clash between cane and rice harvesting necessitates the growing of the early maturing (often low yielding) varieties. It will be seen from Table I that in the 1944–45 season the canefarmers of the Division represented 58 per cent of the total number of recorded rice producers and were responsible for the production of 40 per cent of the total crop.

The average area of rice grown by canefarmers is 1·4 acres as compared with 2·7 acres for other cultivators. There are few farmers who rely upon rice as their main crop or source of income. During the war period most canefarmers have not only greatly increased their production of rice but have also turned their attention to the cultivation of higher yielding varieties such as Ramcajara and New Guinea. In view of these circumstances the steady increase in the popularity of the former variety is recorded. The distribution of pure line seed by the Department of Agriculture was commenced in 1942 as recorded by the writer [5] and during the present season a total of some 500 acres of this variety has been grown in the Nausori area, of which 375 acres was put in by canegrowers. In this district Ramcajara ranks as the second most important, (Table III).

Many storekeepers, transport drivers, mechanics and labourers cultivate rice in their spare time or with the help of paid labour. Very often the results are poor owing to neglect of the crop at the critical periods and to the periodic difficulty of obtaining labour to assist with essential seasonal work. Frequently crop failure is seen where growers both resident and absentee have undertaken too much and have planted an area in excess of their ability to cultivate it properly. The maximum area advisable for a resident small-holder with only his family to assist him would appear to be three acres: if he has other preoccupations half an acre may be all he can manage efficiently. To be self supporting in rice an average Indian family requires to cultivate reasonably well between three quarters and one acre.

The biological factors influencing padi production may be considered briefly.

Varieties.

The principal varieties grown in the Division are shown below, Table III—

Table III.

Padi Varieties, Southern Division, 1945.

Variety.	Districts: Crop in acres.				Total (acres).
	Ra.	Tailevu N.	Rewa.	Navua.	
China Patna (=N.Z.)	770	133	2,125	246	3,274
Serea Patna (=Lalka)	544	97	166	..	807
New Guinea	52	59	122	454	687
Ramcajara	..	65	523	1	589
Motka (=Round)	267	13	97	10	387
Basmatia, white (=Patalka, Mehi)	132	17	48	155	352
Rewa patna (=Lakari, Patna) ..	153	2	118	..	273
Karia patna	67	10	19	2	98
Chetua (=Gagi)	75	7	1	13	96
Sonacalif	29	26	1	..	56
Motmuria	..	5	3	2	10
Basmatia, red (=Lalka patna) ..	..	..	..	75	75
Java (=Lalka serea, Bandala) ..	43	27	..	..	70
B.G. 75	..	34	34	..	48
Rambhog	43	..	..	..	43
"Bichua"	..	16	..	..	16
B.G. 79	..	..	1	1	2
D 116	..	..	2	..	2
Total area per district	2,175	511	3,240	959	6,885

Average yields, degree of popularity and growth periods of the six most important varieties are given in Table III. In 1941, as recorded in this *Journal* (5) the total area under Ramcajara was only 30 acres as compared with 588 acres recorded for the present year. This variety is being introduced to growers in Ra, Navua and elsewhere.

Table IV.

Padi Varieties, Rewa and Tailevu Districts, 1945.

Variety.	Area		Average yield: bushels per acre.	Growth period.
	Acres.	Per cent.		
China Patna	2,258	61	40	170 days.
Ramcajara	588	20	50	150 „
Serea Patna	263	7	35	150 „
New Guinea	181	4	45	165 „
Rewa Patna	120	3	35	150 days
Motka	110	3	40	180 „
Others (11 varieties)	231	6	..	....

* Bushel weight = 50 lb.

The variety New Guinea which is the principal one in Navua is steadily gaining ground in other areas. In 1941 only four acres were grown in the districts covered by the above table.

There are altogether 19 varieties grown, many of these are characteristically low yielders the cultivation of which cannot be regarded as economic. The reasons for the retention of such types are usually given as traditional although there is no doubt that superior flavour and quality play a part.

The milling outturn of several varieties may be given, viz. Motka 70 per cent, Ramcajara 75 per cent, China Patna 65 per cent; but losses due to insufficient drying of grain and bad milling practices are frequently heavy resulting in a considerable all over loss of essential food.

A very great deal remains to be done in the way of encouraging the cultivation of varieties which will give uniformly higher yields under local conditions. This will of course mean the abandonment of certain of the lesser varieties at present under cultivation.

Diseases.

Generally speaking rice in Fiji is very free from fungal diseases and such that do occur are connected with varietal susceptibility or local condition. The following have been observed to cause losses of crop.

1. "Blast" caused by the fungus *Piricularia oryzæ* occurs sporadically in certain varieties as Patalka and Motka.

Fortunately these are not commonly grown and total loss of crop is therefore slight.

2. Leaf spot diseases *Helmithosporium oryzæ*, are widespread in occurrence but do not seriously effect the crop except when physiological condition of soil and climate are adverse. Cases in Bua, Vanua Levu and parts of Viti Levu of severe local damage have been recorded at intervals.

3. False smut (*Ustilaginoidea urens* cke.) is widespread; but severe infection is usually very local and confined generally to certain varieties as, e.g. Motka. Occasionally a field is heavily infected with resultant loss of grain.

4. "Yellows." The obscure condition referred to locally as rice yellows or "vunga" and attributed by Lever (1 & 2) to the sap sucking insect *Sogata furcifera* Horr. is annually met with throughout the Division.

It is normally confined to low lying parts of the field and to late planted crops. All varieties exhibit the condition, which does not appear to bring about any serious loss in yield. Very frequently lack of weeding with an early overgrowth of sedges and other weeds is a contributing factor and it is significent that where good cultural methods are adhered to this condition does not occur. The matter is being further investigated.

5. *Sclerotium oryzæ*, a disease of the roots and crowns is occasionally severe in upland rice on forest soils and on newly cleared land and also in wet land varieties on the edges of fields. No major occurrence has been reported.

Pests of rice are numerous. Amongst the animals are pigs, birds, rats and insects. Wild pigs especially in parts of Ra province have caused losses in fields on the outskirts of settlements and such attacks have led in some places to the abandonment of holdings.

The bird pests of rice are mainly doves, finches, java sparrows, wild duck and bulbuls. These attack the grain in the "milk" stage and cause heavy losses of crop especially in small isolated fields surrounded by trees or scrub in which the birds shelter. These losses are frequently of the order of 25 per cent to 30 per cent of the crop and to avoid this, labour is expended in the task of watching maturing fields from dawn until dusk.

Rats and mice play havoc with grain in fields especially where lodging due to wind and rain has occurred. They also take toll of stored grain and losses may be considerable.

In the field the main insect pests have been recorded by Lever (9). Of annual concern to the farmer are the cutworms (*Prodenia litura* and *Cirphis unipunctata* Horr.) which attack seed beds and also maturing rice plants. Serious losses have been recorded in the latter case when the caterpillar,

by eating the base of the inflorescence causes the head of grain to fall to the ground. Yields have been reduced from 15 bags per acre to two or three bags.

Leaf rollers (*Marasmia*) and other insects are common and do damage to growing crops especially during dry weather.

The loss of stored grain due to predatory weevils, etc., is also considerable.

The writers wish to acknowledge the valuable co-operation of the Manager in Fiji and Officers of the Colonial Sugar Refining Company Ltd. for supplying data relating to rice cultivation.

The considerable contribution made by the writer's Field Assistants B. Ramnath, M. Sami and M. Haripal and B. Maharaj in the compilation of field records is also acknowledged.

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THE RELATION OF PASTURE GROWTH TO PERIODS OF FEED REQUIREMENT.

By

J. J. C. SUCKLING, Dip. Dairying (Massey College),
Agricultural Assistant.

MUCH attention has recently been directed towards the improvement of pasture, especially with regard to the control of weeds and the establishment of better grasses. The fact remains, however, that pasture as a crop is subject to seasonal variations and it is the intention of this note to stress the importance of maintaining food requirements in spite of seasonal fluctuations.

It being accepted that: (*a*) after the first month in milk, production diminishes as lactation progresses; (*b*) the food requirements of a cow depend upon the amount of milk she is giving; and (*c*) pasture growth is not continuous throughout the year; it is obvious that for best returns a balance between calving dates and normal season pasture peaks should be aimed at.

Fiji's system of continuous dairying does not take this factor into account. There are several very sound reasons put forward supporting the local system—labour difficulties, infertility, mildness of the winter, etc., and until organized trials are conducted disproving them, the system will remain. To-day, rightly or wrongly, cows are coming into profit throughout the year and as a result, that section of the herd calving from February to June, unless otherwise provided for, is not able to produce to full capacity simply because there is not sufficient nourishment in the pasture to enable the animals to do so.

In general, active pasture growth commences in September and continues until December. There is a drop off in feed in January, but pastures usually recover in February after which the trend is downwards to minimum growth in July and August. Farms featuring quantities of sensitive plant in the pasture usually show an increase in June. It is clear then that the August–September calver has a potential for producing more fat than her later calving sister, other things being equal. The period during which she is physiologically most capable of producing milk will coincide with the normal seasonal flush of pasture growth. For the remainder of the herd, it follows that supplementary food must be provided if the spring flow of milk is to be maintained. Such additional food could be furnished by holding in reserve certain fields especially for periods of shortage, but the average farm is stocked to its full capacity based on what it can carry during the *best* months of the year. It is customary later, when overstocking threatens, to dispose of surplus animals, but unfortunately by then the milking herd has in many cases been severely handicapped.

Additional food may be provided in the form of concentrates, and some farmers now feed coconut meal and rice bran to their milkers with striking results, but is it not sound economy to produce as much as is possible of the farm's requirements on the farm itself? Sensitive plant, as mentioned, provides valuable winter feed where it occurs in pastures. The recent legume introductions, *Stylosanthes*, *Centrosema*, *Desmanthas*, *Pueraria*, show considerable promise, but they are yet in the trial stage.

The crop which has satisfied requirements in countries where the problem has been faced and which suggests itself as suitable in Fiji, is maize in conjunction with a legume Maize itself is an excellent food; it is quick growing, heavy yielding—15 to 20 tons green crop per acre—is palatable and easily handled. Unfortunately on analysis (*see* table) its nutrient ratio is too wide to be used alone as feed for milking cows; but when fed with a high protein-carrying plant such as cowpea this deficiency is made up. Cowpea answers to all the requirements of the protein crop. It is heavy yielding, has a growth rate similar to maize, and is compatible—in that it neither smothers the maize nor is itself unable to thrive in competition with maize. Soya bean with five per cent protein (green crop) is another legume which would meet requirements except that its establishment on new areas presents certain problems.

The maize and cowpea are sown at the same time and in the same drills. The seed rate per acre is: maize 20 lb and cowpea 15 lb; the crop will be ready for feeding off in 14 weeks. The cost less fencing, using contract labour for ploughing, harrowing and planting an acre should not exceed £4. Thus one ton of valuable stock feed would be produced for the nominal sum of 5s. By sowing a succession of this forage crop during March and April, provision will be made for the two worst months of the year. Fed at the rate of 35 lb per head per day the forage from one acre would maintain an average herd of 60 head at full production for two to three weeks.

Other advantages suggest themselves for utilizing a small section of the farm for this purpose. In the ordinary routine of pasture renovation, ploughing is necessary; so the costs of preparing for the forage crop can be spread over a wider range of operations. By a continuous programme of supplementary forage cropping a small section of the farm each year, followed by the planting up of good quality grasses, the farm will ultimately have been entirely subjected to the rejuvenating process.

Finally by providing for the out-of-season shortages, the carrying capacity of the farm can be maintained or even increased giving greater returns per acre which is the final basis of assessing the value of a farm.

TABLE SHOWING COMPOSITION OF FODDER PLANTS.(1)

FODDER COMPOSITION BY ANALYSIS—PER CENT GREEN CROP.

	Water.	Dry matter.	Protein.	Fat.	Carbohydrate		Ash.	Nut. Ratio.
					Sol.	Fibre.		
Maize..	55·10	44·90	3·95	0·70	26·45	12·20	1·60	13·5
Cowpea	80·82	19·18	3·03	0·33	8·68	5·86	1·28	5·0
Maize and cowpea ..	60·95	39·05	3·17	1·06	23·76	9·49	1·51	11·2

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CORRESPONDENCE.

Department of Agriculture,
Province of British Columbia, Canada,
Victoria, 27th April, 1945.

The Librarian,
Department of Agriculture,
Suva, Fiji.

Dear Sir,

In Volume 16, No. 1 of the March issue of your *Agricultural Journal*, on page 30 appears an interesting item from an American publication, "Vitamin B Repels Mosquitoes."

Am myself very allergic to mosquitoes, and by accident years ago found a remedy in the old fashioned spring medicine, "brimstone and treacle." Mosquitoes apparently do not like the sulphurous content of one's body perspiration. When away from home I have found the ordinary sulphur tablets obtainable at chemists' or druggists' just as efficacious. About three tablets a day are sufficient.

Yours truly,

J. R. TERRY,
Poultry Commissioner.

ANTIMOSQUITO VITAMIN.

"ANTIMOSQUITO VITAMIN. Are you preferred bait for mosquitoes? If so, a medical adviser assures us that by taking vitamin D (thiamin chloride), a person is not only made tolerant to the toxins of the mosquito bites, but a situation is set up in the blood which is highly distasteful to mosquitoes. Persons taking thiamin chloride have noticed that their perspiration has a peculiar odor and that whenever a mosquito alights on the skin, it departs in haste. Putting the thiamin on the skin seems to have no effect. It must be taken internally to produce the action." *The Rotarian*, June, 1945.

The above letter and extract from an American magazine may prove of interest to readers who are particularly prone to mosquito bites. During the war attention has been chiefly concentrated on external applications which make the skin repellant to the mosquito but internal medication, when possible, has the advantage of being less messy and less trouble.

—EDITOR, *Agricultural Journal*.

NOTE.—At the request of the Director of Agriculture, Mr. J. P. Bayly agreed to give an account of his experience in mechanical eradication of guava on his Rasikula property. This will be of general interest to farmers and graziers.

The Editor,
Agricultural Journal. 29th November, 1945.

Sir,

In reply to your request for an account of work on the wild guava pest at Nasigatoka I send the following:—

After a good many years of experience—some of them bitter ones—and unsuccessful attempts to eradicate the wild guava, the details of which I need not weary you with, I think I have at last hit upon the only way to tackle it. That way is to first bulldoze the bush down and then plough and cross plough with a fourteen furrow stump jump disc plough. This work has been actually done on a decent size scale on my Rasikula property, Nasigatoka River, and with good results—at any rate with infinitely better results than I have ever achieved during the years of struggle in the past. The following is a brief summary of how the job was tackled and of the results achieved.

The area worked is just on 100 acres, all flat land lying between the up river road and the river. The guava was mostly a thick bush 7 to 8 feet high. A 30 h.p. caterpillar tractor with bulldozer attached was put straight at the bush. The guava went down before the bulldozer like ripe grain before the harvester. And the bigger the guava the better the bulldozer tore it out. It was the small spindle-like guava that bent before the onslaught and after the bulldozer had passed a good deal of it sprang back again. If there was much of this thin guava it would be necessary to cross-bulldoze the area but in 90 to 100 per cent with old man guava one bulldozing should suffice.

With the bulldozing finished, labourers were put on to clean up the area ready for the plough. This work consisted in stacking the fallen guava in rows and cutting out any of the thin guava still left, which was also stacked in the rows. As soon as conditions were suitable—in our dry climate guava is soon dry enough to burn—the stacked guava was burnt. The 14-furrow stump jump plough was then brought in and the area ploughed and cross-ploughed. And thanks to some good rains that we had in September and October there is already quite a fair show of feed. Thus an area that less than a year ago was practically a useless guava scrub is capable now of carrying stock, thanks to this mechanical work. "Nawai" grass which some years ago had been planted in different parts of this flat is showing up and the burning off—though I am not fond of burning—has brought a fair show of sensitive plant, one of the very few legumes which cattle men in Fiji have to depend on.

Unfortunately the tractor, a second-hand one I had bought, broke down, or rather the bulldozing part of it. So the bulldozing work has had to stop as I have not been able to replace the broken part. And it seems impossible to find out when I can get a new part. So the work is held up.

I append hereto costs of the work to the nearest 1s. per acre.

1st bulldozing	11s.	per acre.
Stacking and burning . ..	10s.	,,
1st ploughing	9s.	,,
2nd ploughing	7s.	,,
Total ..	37s.	per acre.

This does not include wear and tear and depreciation of machinery.

After feeding the area down and thus getting some good out of it, I propose at the end of the coming wet season to again plough the paddock. This will be about next May. Subsequent to this ploughing I propose to put a unit or two on with a mattock and yam spade to grub out the few remaining guava roots that may be left. Then with a good sward of "Nawai" grass growing I expect the guava to be beaten and not to come back.

We are new on this method of eradicating guava and we are bound to find out small improvements as we go along. And to me of all the different ways I have tried through the years, there is none that can compare. And the beauty of it is that in this dry climate with proper equipment that doesn't break down, one can get such a big area cleaned up in so short a space of time. Again, and perhaps what is more important in these days of labour unrest and shortage, one can be independent of big gangs of men.

I am, etc.,

JOHN P. BAYLY.

RICE YIELDS OVERSEAS.

In the issue of the *Fiji Times and Herald* for 12th November a letter signed by "Interested" requested information on yields of rice or padi in other countries. This information, abstracted from various publications, is given below:—

		Average yield per acre.
1934	Africa—Nyasaland and Sierra Leone .	1,000/1,400 lb
1930	British Guiana—	
	Wet land	868 lb
	Irrigated land	Up to 5,200 lb
1932	California—	
	Irrigated land	4,000/4,500 lb
	Non-irrigated	1,800/2,200 lb
1934	Malaya—	
	Wet land	1,500 lb
	Dry land	800 lb.

This issue contains a further article on rice production which gives actual yields for certain varieties within the Southern Division and will also be of general interest.

—H.R.S.

DESTRUCTION OF SCIENTIFIC INSTITUTES IN THE PHILIPPINES.

Information has been received that the buildings of the Bureau of Science Manila, have been utterly destroyed in the fighting for that city; and, moreover, it is reported that the Japanese have destroyed the Philippine College of Agriculture at Los Banos, eastward of Manila. The loss of the scientific collections and libraries in the Bureau of Science is irreparable. The Bureau took shape in January 1906, by the union of the Bureaux of Government Laboratories and Mines, and was charged with investigations in bacteriology, immunity, prophylaxis, etiology, botany, various branches of zoology (in particular entomology), technological chemistry, geology and mining engineering. The whole structure has gone—the records of the work of forty years; for the two Bureaux named had been at work for four years before the Bureau of Science was formed.

—*Nature*, Vol. 155, June 30, 1945.

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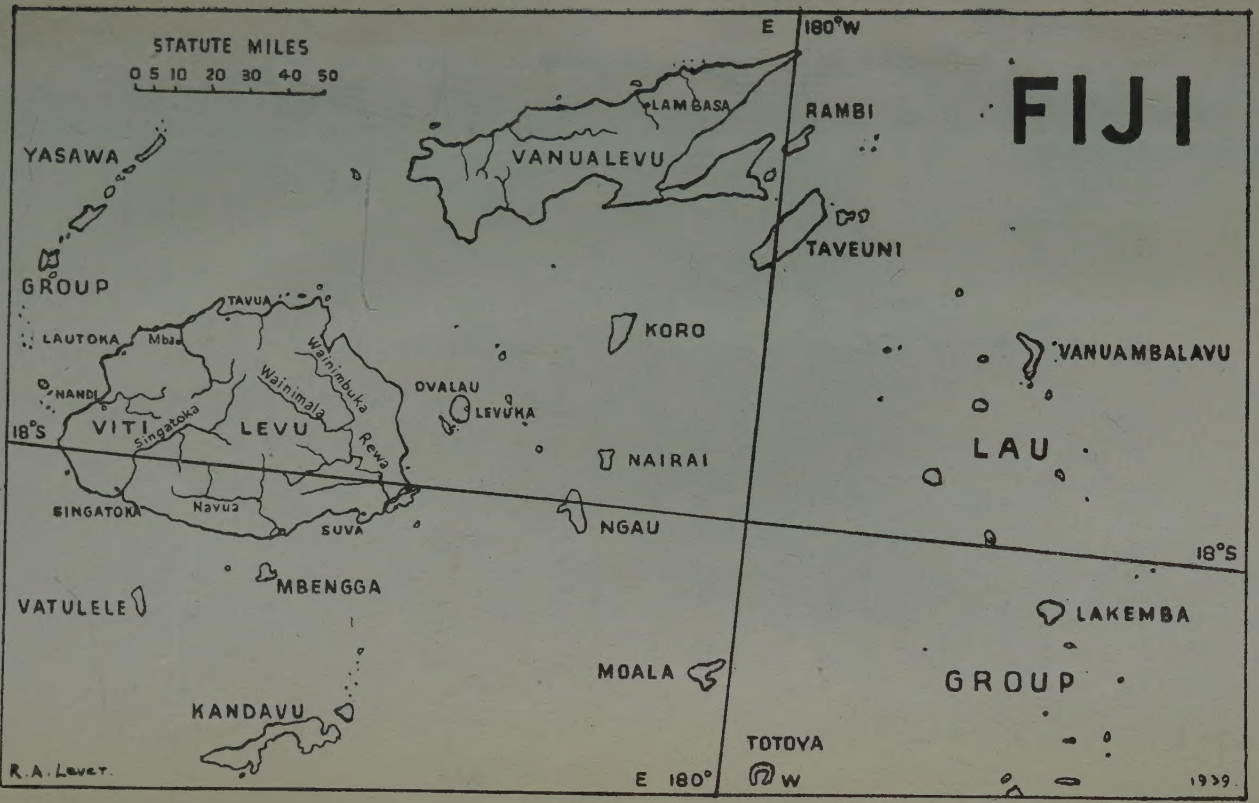
—R.J.A.W.L.



So as to include Kadavu and Totoya within the framework available the map has been rotated some 6° to the east.

65/1P2

NASINU FARM

The Department of Agriculture has, at the Stock Farm, Nasinu, the following :—

FOR SALE :

Tamworth Boars, progeny of high grade sows recently imported from New Zealand in pig.

Red Poll Bulls, 6 months old, bred from the Nasinu Red Polls.

Large White Yorkshire Boars, of excellent type from the Nasinu sties.

FOR SERVICE :

Recently imported from New Zealand :—

Red Poll Bull—" Adderstone Victor."

Tamworth Boar—" Saltash Melba's Prince."

Bred at Nasinu :—

Large White Yorkshire Boars.

GARDENING NOTES by H. R. SURRIDGE, **INSECT PEST CONTROL** by R. J. A. W. LEVER and **PLANT DISEASES** by B. E. V. PARHAM.

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